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optical switch in a last column of the matrix requires controlling the switching means of only one of the plurality of polarization control optical switches in the matrix.

REMARKS

In the Office Action mailed on January 29, 2002, claims 23, 26, 28, and 30 were rejected under 35 U.S.C. § 112, first paragraph, for lack of enablement; claim 32 was rejected under 35 U.S.C. § 112, second paragraph, for indefiniteness; claims 32-38 were rejected under 35 U.S.C. § 102(b) as being anticipated by Healey et al. (U.S. Patent No. 5,013,140) ("Healey"); claims 32-38 were rejected under 35 U.S.C. § 102(b) as being anticipated by Yamamoto (U.S. Patent No. 5,162,944) ("Yamamoto"); and claims 32-38 were rejected under 35 U.S.C. § 102(e) as being anticipated by DeJule et al. (U.S. Patent No. 5,317,445) ("DeJule"). The Applicant respectfully traverses the foregoing rejections.

Claims 23-38 are pending in the subject application, of which claims 23, 25, 26, 28, and 30-38 are under consideration. Claims 24, 27, 29, and 31 have been withdrawn from consideration as non-elected. Claims 26, 32, 33, 35, 36, and 38 are amended. Care has been exercised to avoid the introduction of new matter. A Version With Markings To Show Changes Made to the specification and amended claims is included herewith.

Claim 25:

In item 2, on page 2 of the Office Action mailed on May 22, 2001, the Examiner referred to claim 25 as being withdrawn from consideration as being drawn to a non-elected species and invention. However, in the Applicant's election of species dated February 28, 2001, the Applicant elected claims 25, 26, 28, and 30 to continue prosecution in the subject application. Claim 23 had been indicated as a generic claim and was, therefore, not subject to restriction.

The Applicant considers claim 25 as being under consideration for purposes of this Amendment, and respectfully requests that the Examiner acknowledge the same.

Foreign Priority:

It is noted that the Examiner has acknowledged the Applicant's claim for priority under

35 U.S.C. § 119 and the receipt of a certified copy of the priority application in the parent case, in an Office Action mailed on March 7, 1996 (U.S. serial number 08/200,657). The Applicant respectfully requests that the Examiner acknowledge the same in the subject application.

Claims 26, 33, 35, 36, and 38:

Claims 26, 33, 35, 36, and 38 are amended herein to improve clarity.

Rejections of Claims 23, 26, 28, and 30 Under 35 U.S.C. § 112, first paragraph:

The Specification, at page 12, line 22 – page 14, line 25, provides support for the claimed recitation “wherein switching light from one input to one output requires controlling only one of said first, second and third elements.” Specifically, page 14, lines 10-13 of the Specification provides that “[i]n this manner, light path switching can be accomplished just by controlling only one switch element, and along any path thus set, the light information passes through four switch elements.” The Applicant respectfully requests that the Examiner withdraw the rejections of claims 23, 26, 28, and 30.

Rejection of Claim 32 Under 35 U.S.C. § 112, second paragraph:

Claim 32 is amended, taking the Examiner’s comments into consideration. The Applicant respectfully requests that the Examiner withdraw the rejection of claim 32.

Rejections Under 35 U.S.C. § 102(b) (Healey):

Healey discloses an optical space switch comprising an optical output; three optical deflection stages each having a twisted-nematic liquid crystal polarization rotator responsive to a respective bi-state control signal and a calcite crystal deflection means for selectively deflecting optical signals according to their polarization (Healey, Abstract).

In contrast, claims 32, 33, 35, 36, and 38 of the subject application (as amended herein) each recite “requires controlling the switching element of only one of the plurality of polarization control optical switches.”

In the Healey apparatus, control of multiple rotators R1-R3 is required to switch light

from one of a plurality of inputs to one of a plurality of outputs (Healey, col. 3, lines 39-56). Clearly, Healey does not anticipate claims 32, 33, 35, 36, and 38 of the subject application. Claims 34 and 37 of the subject application are allowable based on their dependency from deemed allowable claims 33 and 36, respectively. The Applicant respectfully requests that the Examiner withdraw the rejections of claims 32-38.

Rejections Under 35 U.S.C. § 102(b) (Yamamoto):

Yamamoto discloses an optical space switch that includes a polarization controller, a beam splitter, a first reflection block, and a second reflection block (Yamamoto, Abstract). The polarization controller has a first mode and a second mode (Yamamoto, Abstract). The polarization controller maintains the polarization of input light in the first mode and changes it by 90 degrees in the second mode (Yamamoto, Abstract). The first reflection block includes a quarter wave plate and a light path changing element (Yamamoto, Abstract). The input light from the polarization beam splitter is reflected by the first reflection block (Yamamoto, Abstract). During this time, the input light passes through the quarter wave plate twice (Yamamoto, Abstract). The polarization of the input light is changed by 90 degrees (Yamamoto, Abstract).

In contrast, claims 32, 33, 35, 36, and 38 of the subject application (as amended herein) each recite "requires controlling the switching element of only one of the plurality of polarization control optical switches."

In the Yamamoto apparatus, control of multiple polarization controllers is required to switch light from one of a plurality of inputs to one of a plurality of outputs. Specifically, Yamamoto discloses a plurality of optical space switches (Yamamoto, Figs. 13A-C, 17A), each space switch comprising a polarization controller array 2A, which itself comprises a plurality of eight polarization controllers aligned in a line, each controller being connected to a signal source for individual control (Yamamoto, col. 14, lines 33-42). To control each controller, two XOR operations are required, and each controller is individually set to ON or OFF depending on the result of the XOR operation (Yamamoto, col. 16, lines 29-46). Clearly, Yamamoto does not anticipate claims 32, 33, 35, 36, and 38 of the subject application.

Claims 34 and 37 of the subject application are allowable based on their dependency from claims 33 and 36, respectively. The Applicant respectfully requests that the Examiner withdraw the rejections thereto.

Rejections Under 35 U.S.C. § 102(e) (DeJule):

DeJule discloses an optical switching device for switching linearly polarized optical signal beams including a plurality of switching cells arranged in matrix form (DeJule, Abstract). Each switching cell has spatial light modulators and a polarizing beam-splitter that cooperate to propagate the optical beams received by the device to selected output ports (DeJule, Abstract).

In contrast, claims 32, 33, 35, 36, and 38 of the subject application (as amended herein) each recite "requires controlling the switching element of only one of the plurality of polarization control optical switches."


DeJule requires a control signal for each switching cell in the matrix to switch light from one of a plurality of inputs to one of a plurality of outputs (DeJule, col. 5, lines 18-61; Fig. 2). Clearly, DeJule does not anticipate claims 32, 33, 35, 36, and 38 of the subject application. Claims 34 and 37 of the subject application are allowable based on their dependency from deemed allowable claims 33 and 36, respectively. The Applicant respectfully requests that the Examiner withdraw the rejections thereto.

Withdrawal of the foregoing rejections is respectfully requested. There being no further objections or rejections, it is submitted that the application is in condition for allowance, which action is courteously requested. Finally, if there are any formal matters remaining after this response, the Examiner is requested to telephone the undersigned to attend to these matters. If there are any additional fees associated with filing of this Amendment, please charge the same to our Deposit Account No. 19-3935.

Respectfully submitted,

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Date: 5-29-2002

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE CLAIMS:

Please AMEND claims 26, 32, 33, 35, 36, and 38. The remaining claims are reprinted, as a convenience to the Examiner, as they presently stand before the U.S. Patent and Trademark Office.

23. (AS ONCE AMENDED) A polarization control optical space switch comprising:
a plurality of polarization control optical switches cascaded together;
wherein each polarization control optical switch comprises:
a first polarization controller that is capable of changing the polarization of light incident thereon by one of applying voltage thereto and not applying voltage thereto;
a first element to change the optical path of light from said first polarization controller;
a delay plate to change the polarization of light incident thereon from said first element; and
a second element to change the optical path of light from said delay plate; and
a final polarization control optical switch comprising:
a second polarization controller that is capable of changing the polarization of light incident thereon by one of applying voltage thereto and not applying voltage thereto; and
a third element to change the optical path of light from said second polarization controller,
wherein said polarization control optical space switch has a plurality of inputs and the same number of outputs, and
wherein switching light from one input to one output requires controlling only one of said first, second and third elements.

24. (AS ONCE AMENDED) A polarization control optical space switch according to claim 23, wherein said delay plate includes segments that do not delay light incident thereon.

25. (AS ONCE AMENDED) A polarization control optical space switch according to claim 23, wherein said first element to change the optical path of light from said first polarization

controller and the second element to change the optical path of light from said delay plate only change the optical path of p-polarized light.

26. (TWICE AMENDED) A polarization control optical space switch according to claim 23, wherein said first element to change the optical path of light from said polarization controller and the second element to change the optical path of light from said delay plate only change the optical path of s-polarized light.

27. (AS ONCE AMENDED) A polarization control optical space switch according to claim 23, wherein said first element to change the optical path of light from said first polarization controller changes the optical path by moving light incident at the i -th input thereto to one of the $(i-1)$ th and $(i+1)$ th output.

28. (AS ONCE AMENDED) A polarization control optical space switch according to claim 23, wherein said second element to change the optical path of light from said delay plate changes the optical path by moving light incident at an i -th input thereto to one of an $(i-1)$ th and an $(i+1)$ th output.

29. (AS ONCE AMENDED) A polarization control optical space switch according to claim 23, wherein said first element to change the optical path of light from said first polarization controller is a downward polarizing beam splitter, which reflects incident light with a predetermined polarization input on the i -th input to the $(i+1)$ th output.

30. (AS ONCE AMENDED) A polarization control optical space switch according to claim 23, wherein said second element to change the optical path of light from said delay plate is an upward polarizing beam splitter, which reflects incident light with a predetermined polarization input on an i -th input to an $(i-1)$ th output.

31. (AS ONCE AMENDED) A polarization control optical space switch according to claim 23, wherein the first element to change the optical path of light from said first polarization controller is constructed from a polarizing beam splitter array consisting of a combination of polarizing beam splitters.

32. (ONCE AMENDED) A polarization control optical space switch comprising:
a plurality of polarization control optical switches connected together between a plurality of inputs and a corresponding plurality of outputs, each of said plurality of polarization control optical switches comprising:

a polarization controller changing the polarization of the light incident thereon by one of applying voltage thereto and not applying voltage thereto; and

a switching element changing the optical path of the light from said polarization controller, wherein switching light from one of said plurality of inputs to one of said plurality of outputs requires controlling [only one] the switching element of only one of the plurality of polarization control optical switches. [provided in the respective one of said plurality of polarization control optical switches.]

33. (ONCE AMENDED) A polarization control optical space switch comprising:
polarization control optical switches, each having a plurality of inputs and a plurality of outputs and connected together as a matrix defined by columns and rows, each of the polarization control optical switches comprising:

a polarization controller changing the polarization of light received by a respective input of the respective polarization control optical switch and incident on the polarization controller by one of applying voltage thereto and not applying voltage thereto, and

a switching element selectively outputting the polarization changed light to a respective output of the respective polarization control optical switch,

wherein switching light from a respective input of a respective polarization control optical switch in a first column of the matrix to a respective output of a respective polarization control optical switch in a last column of the matrix requires controlling [only one] the switching element of only one of the plurality of polarization control optical switches in the matrix.

34. (AS ORIGINAL) A polarization control optical space switch as in claim 33, wherein the matrix is an N x N matrix.

35. (ONCE AMENDED) An apparatus comprising:
an optical space switch comprising:
polarization control optical switches, each having a plurality of inputs and a plurality of outputs and connected together as a matrix defined by columns and rows, each of

the polarization control optical switches comprising:

a polarization controller changing the polarization of light received by a respective input of the respective polarization control optical switch and incident on the polarization controller by one of applying voltage thereto and not applying voltage thereto, and
a switching element selectively outputting the polarization changed light to a respective output of the respective polarization control optical switch,

wherein switching light from a respective input of a respective polarization control optical switch in a first column of the matrix to a respective output of a respective polarization control optical switch in a last column of the matrix requires controlling [only one] the switching element of only one of the plurality of polarization control optical switches in the matrix.

36. (ONCE AMENDED) A polarization control optical space switch comprising:
polarization control optical switches, each having a plurality of inputs and a plurality of outputs and connected together as a matrix defined by columns and rows, each of the polarization control optical switches comprising:

a polarization controlling means for changing the polarization of light received by a respective input of the respective polarization control optical switch and incident on the polarization controlling means by one of applying voltage thereto and not applying voltage thereto, and

a switching means for selectively outputting the polarization changed light to a respective output of the respective polarization control optical switch,

wherein switching light from a respective input of a respective polarization control optical switch in a first column of the matrix to a respective output of a respective polarization control optical switch in a last column of the matrix requires controlling [only one] the switching means of only one of the plurality of polarization control optical switches in the matrix.

37. (AS ORIGINAL) A polarization control optical space switch as in claim 36, wherein the matrix is an $N \times N$ matrix.

38. (ONCE AMENDED) An apparatus comprising:
an optical space switch comprising:
polarization control optical switches, each having a plurality of inputs and a plurality of outputs and connected together as a matrix defined by columns and rows, each of

the polarization control optical switches comprising:

a polarization controlling means for changing the polarization of light received by a respective input of the respective polarization control optical switch and incident on the polarization controlling means by one of applying voltage thereto and not applying voltage thereto, and

a switching means for selectively outputting the polarization changed light to a respective output of the respective polarization control optical switch,

wherein switching light from a respective input of a respective polarization control optical switch in a first column of the matrix to a respective output of a respective polarization control optical switch in a last column of the matrix requires controlling [only one] the switching means of only one of the plurality of polarization control optical switches in the matrix.